

**SYSTEM FOR COLLECTING VEHICLE DATA AND DIAGNOSTICATING  
THE VEHICLE USING USB HARD DRIVE**

**5 Technical Field**

The present invention relates to a vehicle diagnosis and management system using a USB hard drive. More particularly, the present invention relates to vehicle diagnosis system enabling vehicle diagnoses by collecting data occurring from a vehicle and reading the collected vehicle-related data on-line and off-line in use of the USB hard 10 drive and a USB control unit.

**Background Art**

Prior vehicle maintenance and management basically has lots of non-systematic and arbitrary sides. A driver relies on his own vehicle-related knowledge as to various 15 normal and abnormal functions of the vehicle or is able to judge if the vehicle functions are normal or abnormal through check engine warning lights and the like on the dashboard which are transferred from the engine control unit (ECU) of the vehicle. In addition, a vehicle repair shop suffers difficulties as to precise judgments since no grounds on obvious signs exist as to various problems, such as poor ignition, engine trouble, 20 transmission trouble, abruptly or continuously occurring in diverse vehicle circumstances such as the starting and driving of the vehicles and the like, so that most vehicle repairs are carried out based on mechanics' experiences due to difficulties as to precise judgments. Accordingly, different diagnoses are made among mechanics based on their experiences as to the same vehicle problem, and the cases that improper maintenances are carried out on

the basis of their experiences exist all the time, which has a serious influence on vehicle safety as well as which causes various problems such as vehicle lifespan reduction, repair cost increase, distrust on vehicle sale companies, and so on.

In the meantime, in replacing vehicle consumables every certain period for  
5 enabling the maintenance of the optimal states of a vehicle, since a driver, at present, replaces the consumables either based on driver's incorrect knowledge on vehicle consumables replacements or by asking a mechanic one by one whether the consumables replacements are necessary whenever the driver visits repair shops, it is impossible to maintain optimal vehicle states, which causes the aforementioned various vehicle  
10 maintenance problems.

In order to provide some solutions to such problems, in conventional, an individual himself prepares a vehicle management note and records consumables replacements or repair contents in detail or some repair shops do the recordation and management for the vehicle management note for the purpose of recruiting customers.  
15 However, such methods are very inconvenient since a user, for the former case, writes maintenance and consumables replacement contents one by one as well as have high possibility for the contents to be missed due to user's mistakes and the like. Further, for the latter, more systematic managements are available than the former, but it is a problem that the user has to be a customer of one designated repair shop. In recent,  
20 lots of programs appear to manage materials in a form of the vehicle management note and to provide various additional services by using the internet as to vehicle consumables replacement periods, but, for this, a user has to input data one by one as in the above vehicle management note, and environmental restriction conditions exist that the user can use the program only when connectable on-line all the time.

In the meantime, with respect to vehicular convenience apparatus settings, in conventional, the vehicular convenience apparatus is adjusted by using only various mechanical devices, but, in recent, with introductions of various electronic systems within a vehicle, such convenience apparatus settings and adjustments become convenient in a 5 motor-driven manner using electronically controllable motors. However, in case that a vehicle is driven by more than one driver who have different physical conditions and sensitivities, each time one driver uses the vehicle after another, the driver should re-adjust all the convenience apparatus, such as driver's seat position, rear view mirror and room mirror angles, favorite radio frequencies, and so on, to be fit to himself, which causes 10 inconvenience a lot.

### **Detailed Description of the Invention**

The present invention is to solve the above problems, and it is an object of the present to maximize drivers' convenience and differentiate products and services by 15 enabling to systematically diagnose a vehicle and to maintain optimal convenience apparatus settings according to respective drivers.

In more detail, it is an object of the present invention to provide a system and a method enabling drivers to check vehicular consumables replacement periods and whether maintenance is required, take his vehicle to a repair shop when appropriate, and have the 20 consumables replacements and maintenance performed out by collecting and storing output data of various mechanical and electronic devices such as sensors, engine control unit (ECU), transmission control unit (TCU), and the like, in use of a USB hard drive, enabling to diagnose vehicle problems on-line and off-line by using the stored data, analyzing the data and notifying the users of the analyzed results by executing independent programs on-

line as to log data stored in the USB hard drive or by connecting to a server on-line.

Further, it is another object of the present invention to provide, in case of a repair shop, vehicle maintenance system and method enabling systematic and expert vehicle maintenance by reading on-line or off-line the log data stored in the USB hard drive as to  
5 various vehicle problems intermittently or continuously occurring and carrying out the maintenance based on the read data, to thereby enable systematic and integral vehicle diagnoses and managements by storing vehicle maintenance records and consumables replacement records in the USB hard drive.

Another object of the present invention, for vehicle sale companies, is to collect  
10 and database various vehicle maintenance-related data transferred on-line through the USB hard drive, grasp vehicle problems on sale, to thereby use the collected data as basic data for complementing the vehicles on sale and developing new vehicle models in the future.

It is a further object of the present invention to provide a method for providing a driver with more comfortable and convenient driving environments by allowing the driver  
15 to automatically set the driver's convenience apparatus when riding the vehicle in use of the USB hard drive.

In order to achieve the above objects, a system for collecting and diagnosing vehicle data comprises a USB hard drive having vehicle-related data consisting of basic vehicle information data and vehicle maintenance information data; and a USB control unit  
20 connected to electronic control units, mechanical control units, and sensors within a vehicle, and for collecting vehicle information, reading the vehicle-related data from the USB hard drive, and storing the collected vehicle information in the USB hard drive. Preferably, the system further comprises a terminal for reading the vehicle-related data from the USB hard drive, carrying out diagnoses, and storing results in the USB hard drive.

The USB hard drive being used in the system of the present invention includes the basic vehicle information data indicating vehicle-inherent information data and information data as to an owner of the vehicle and the vehicle maintenance information data containing data indicating information outputted from various vehicular control units 5 and sensors and data inputted from exterior as to vehicle diagnoses and maintenance.

Further, the USB control unit used in the system of the present invention includes a vehicle interface for inputting data as to vehicle states from the mechanical control units, electronic control units, and sensors inside the vehicle; a first memory for storing data indicating vehicle states collected from the control units and sensors through the vehicle 10 interface; a second memory for storing data transferred from the USB hard drive as to vehicle diagnosis and maintenance items; a third memory for storing vehicle-inherent information data such as vehicle delivery date, frame number, engine number, vehicle kind, year, and displacement volume that are unchangeable items out of the basic vehicle information data; a fourth memory for storing the convenience apparatus setting values of 15 a present driver; a USB communication port for interfacing the USB hard drive and the USB control unit; a processor for controlling the vehicle interface, first memory, second memory, third memory, fourth memory, and USB communication port, and carrying out calculations; and a ROM including a program for controlling the processor.

Further, the terminal used in the system of the present invention includes a USB 20 driver for reading the vehicle-related data from the USB hard drive and storing processed vehicle-related data in the USB hard drive; and a personal computer (PC) for executing a vehicle diagnosis program as to the vehicle-related data read from the USB hard drive, diagnosing the vehicle, displaying maintenance items based on the diagnosis results and storing the results in the USB hard drive, or a mobile communication terminal connecting

to a main server of a central A/S center through a network such as the internet, and receiving and outputting results which are processed in the main server of the central A/S center.

## 5 Brief Description of the Drawings

FIG. 1 is a schematic block diagram for showing a vehicle data collection and diagnosis system on-line and off-line by using a USB hard drive according to an embodiment of the present invention.

FIG. 2 is a block diagram for showing respectively the structures of data to be recorded and updated in the USB hard drive and in a USB control unit according to an embodiment of the present invention.

FIG. 3 is a detailed block diagram for showing the structure of the USB control unit of FIG. 1.

FIG. 4 is a detailed block diagram for showing the structures of a CPU and a vehicle interface inside the USB control unit according to an embodiment of the present invention.

FIG. 5 is a flow chart for illustrating a process for collecting vehicle data in a system according to an embodiment of the present invention.

FIG. 6 is a flow chart for illustrating a process for updating data to the latest between the USB hard drive and the USB control unit in the system according to an embodiment of the present invention.

FIG. 7 is a flow chart for illustrating a process for vehicle diagnosis and repairs in a terminal in a vehicle repair shop.

FIG. 8 is a flow chart for illustrating an on-line vehicle diagnosis process by using

the USB hard drive.

FIG. 9 is a block diagram for showing a structure of an on-line vehicle diagnosis system by using the USB hard drive.

FIG. 10 is a block diagram for showing a central A/S center system.

5 FIG. 11 is a flow chart for illustrating an off-line vehicle diagnosis process by using the USB hard drive.

FIG. 12 is a block diagram for showing a structure of an off-line vehicle diagnosis system by using the USB hard drive.

FIGs. 13a and 13b are flow charts for illustrating a process for automatically 10 setting the vehicular convenience apparatus based on data stored in the USB hard drive according to an embodiment of the present invention.

### Embodiment

Hereinafter, a preferred embodiment of the present invention will be described in 15 detail with reference to the accompanying drawings.

Now, the present invention is described with reference to FIG. 1 and FIG. 3. FIG. 1 is a schematic block diagram for showing an on-line and off-line vehicle data collection and diagnosis system by using a USB hard drive according to an embodiment of the present invention, and FIG. 3 is a detailed block diagram for showing the structure of the 20 USB control unit of FIG. 1.

Referring to FIG. 1, a system for collecting vehicle data and diagnosing vehicles according to an embodiment of the present invention comprises (i) a USB control unit 103 mounted in a vehicle 102, (ii) a terminal 110 of a vehicle repair shop which includes a second USB driver 111 and a personal computer (PC) 112, (iii) a personal terminal 120

including a first USB driver 121 and a PC or a mobile telecommunication terminal 122, and (iv) a central A/S center main server 140 for receiving information on a vehicle 102 from the PC/communication terminal 112 and 122 mounted in the repair shop terminal 110 or the personal terminal 120 and transferring desired vehicle diagnosis and repair data back 5 to the repair shop terminal 110 and the personal terminal 120 through a network 130, which transfer information to each other by means of a USB hard drive 101.

The vehicle 102 in FIG. 1 includes the USB control unit 103 which collects and stores in the first internal memory 301 the latest information on sensors and control units mounted in various vehicular devices, the vehicular normal and abnormal states indicated 10 as error codes, and vehicular changed details indicated as input values for vehicle speed sensors, injector driving signals, and so on, from the sensors and the control units by a method described later, collects and stores in the second internal memory 302 the latest vehicle maintenance information from the USB hard drive 101, and stores vehicular or driver's convenience apparatus setting values in the fourth memory 304. The control 15 units such as TCU, ECU and the like and various sensors are connected to the USB control unit 103 in parallel or serial so as to transfer to the USB control unit 103 and store in the first internal memory 301 data for all the details occurring in a vehicle such as whether or not electronic control units are in malfunction, replacement periods for various consumables, whether or not the engine is in malfunction, and so on, which are collected 20 from the respective control units.

In the meantime, the repair shop terminal 110 in FIG. 1 includes the second USB driver 111 for reading from the USB hard drive and recording in the USB hard drive vehicle-related data, and the computer 112 connected to the second USB driver and for analyzing the data read from the USB hard drive, inputting and storing the details on

whether or not a vehicle is in malfunction, consumables replacement state indications, and vehicle maintenance. Further, the personal terminal 120 in FIG. 1 includes the first USB driver 121 for reading and recording vehicle-related data from and into the USB hard drive, and the maintenance program-installed computer 122 connected to the first USB 5 driver 121 and for indicating details on vehicle state diagnosis and maintenance recommendations off-line to enable self diagnosis, or the computer or communication terminal 122 connected to the first USB driver 121 and for transferring data from the USB hard drive 101 to a central A/S center through a network and indicating the details on vehicle diagnosis and maintenance recommendations on-line to enable self diagnosis.

10 In the meantime, the central A/S center main server 140 in FIG. 1 may be connected to the repair shop terminal 110 and/or the computer or communication terminal 122 of the personal terminal 120.

FIG. 2 is a block diagram for showing the structures of data to be recorded and updated in the USB hard drive and in a USB control unit according to an embodiment of 15 the present invention. First, information recorded in the USB hard drive is classified into basic vehicle information data, vehicle maintenance information data, driver convenience information data, joint application information data and other information data in which the basic vehicle information data is again divided into unchangeable items and updatable items, and the vehicle maintenance data into items updatable from the USB 20 control unit and items updatable from external devices. Further, data stored in the USB control unit is divided into basic vehicle information data, vehicle maintenance data, driver convenience information data, and other information data in which only unchangeable items are stored in the basic vehicle information data, and the vehicle maintenance data is divided into items updatable from various control units and sensors

and items updatable from the USB hard drive.

- The unchangeable items of the basic vehicle information data indicates inherent vehicle information such as vehicle delivery date, frame number, engine number, kind of vehicle, year, displacement volume, and the like, which is information a vehicle maker  
5 stores in the third memory 303 of the USB control unit when shipping out a vehicle. The USB control unit data of these unchangeable item data is once writable upon initial settings but not updatable, and the same area of the USB hard drive only stores the information data of the USB control unit as it is, and after delivered from a factory, it does not allow the date to be changed by other external devices except by the USB control unit.  
10 Further, the updatable items of the basic vehicle information of the USB hard drive are information about a vehicle owner himself such as vehicle purchase date, vehicle purchaser, driver's license number, E-mail and the like, which can be registered through checking the identity of the owner in a designated establishments such as vehicle dealer shops and the like, and such items are recorded only in the USB hard drive rather than in the USB control  
15 unit.

The items, out of the vehicle maintenance information data, to be updated from various control units (CU) are information to be recorded in the USB control unit through detections from the various control units and sensors in a vehicle, which are inputted from self diagnosis connectors and include all the information detectable from sensors mounted  
20 in the vehicle, such as the vehicular normal and abnormal states indicated as vehicle error codes, vehicle speed on the running, average RPM obtained from injector driving signals, engine state information, and so on. Further, the information may be recorded in a history of changed records for a certain period of time such as engine's abnormal signals and the like or in a form of the final record updated such as mileage records and the like,

according to characteristics, which is transferred to the USB hard drive, when the USB hard drive is connected to the USB control unit, to update information data corresponding to the updatable items from the USB control unit.

In the meantime, of the vehicle maintenance information data, the items updatable 5 from external devices, which is in the USB hard drive, include records regarding vehicle maintenance such as A/S dates, A/S items, maintenance contents, replaced parts, and maintenance shop records, which are recorded in the USB hard drive by external devices such as USB drivers 111 and 121 of FIG. 1, and, in case that the USB hard drive is connected to the USB control unit, the central processing unit of the USB control unit 10 compares the data with the existing data stored in the USB control unit and mutually updates the USB hard drive and the USB control unit with the latest data.

The driver convenience data recorded in the USB hard drive 101 and the USB control unit 103 includes information data related to the convenience of individual drivers, such as favorite radio frequency selections, volume controls, audio-related information like 15 CD or EQ setups, vehicle's cabin temperatures, side view mirror adjustments, driver's seat height and tilt, steering wheel's position and tilt, and so on, and, in case of providing plural USB hard drives per vehicle, the driver convenience information data areas of USB hard drive fit to drive holders, respectively, by USB hard drive. Accordingly, in case that a driver gets in a vehicle and connects his USB hard drive, the USB control unit transfers the 20 convenience apparatus information in the USB hard drive to various control units in the vehicle so that the vehicular convenience apparatus is adjusted to be fit for the driver, and, in case that the driver adjusts convenience information-related devices during the driving, the adjusted information is first stored in the USB control unit memory and then the USB hard drive is updated. As a result, the driver convenience apparatus information data

in the USB hard drive is recorded as data set for the convenience apparatus till a USB hard drive holder leaves the vehicle at last.

In the meantime, the USB hard drive may be loaded with applications of companies individually contracted with a driver to provide services such as emergency medical care information, insurance company's vehicle insurance records, gas points accumulation of oil refining companies, theaters, shopping, travels, various mileages, and so on, as joint application information data, in addition to vehicle-related information, so that the USB hard drive may store information enabling a multi-function USB hard drive having multiple functions as a single USB hard drive.

The aforementioned USB hard drive data is initialized by resetting the USB control unit upon the initial use or upon user's necessity. The initialization updates the USB hard drive with the USB control unit data, and, at this time, of the basic vehicle information data, the unchangeable items, vehicle maintenance information data, and driver convenience information data are updated from the USB control unit data, and, of the basic vehicle information data, the updatable items, joint application items, and other information data remain as they are if the existing data is stored in the USB hard drive.

Such initialization is particularly necessary when selling and purchasing a vehicle, and in case that a existing USB hard drive holder purchases a vehicle, the holder, for the purpose of the USB hard drive use, connects the existing USB hard drive to the USB control unit and resets the USB control unit to initialize the USB hard drive and when a purchaser who does not use a USB hard drive takes over a USB control unit-mounted vehicle, he purchases a new USB hard drive separately, connects the new USB hard drive to the USB control unit, resets the USB control unit to initialize the drive, and use the drive, in which the same process is applied when the existing USB hard drive user lost his USB

hard drive.

Hereinafter, referring to FIG. 3 and FIG. 4, descriptions are made on a USB control unit structure and a process for collecting information from various sensors mounted in a vehicle.

- 5       The USB control unit 103 shown in FIG. 3 includes the vehicle interface 307 connected to various control units and sensors in a vehicle for inputting data from the same; an EEPROM comprising the first memory 301 for storing information transferred through the vehicle interface 307, the second memory 302 for storing data, such as maintenance information and the like, transferred from the USB hard drive, the third 10 memory 304 for storing inherent vehicle information upon vehicle delivery, and the fourth memory 304 for storing convenience apparatus setting information of a present driver; a RAM 306 for temporarily storing vehicular internal information or data to be updated from the USB hard drive which is collected before storing information in the first, second, and fourth memories; a USB communication port 305 for interfacing with the USB hard drive; 15 a CPU 309 for controlling the above constituents and performing calculations; and a RAM 308 for storing programs for controlling the CPU 309.

Further, the USB control unit according to an embodiment of the present invention may be designed to include external indicators for characters, images and voices which enable vehicle check-ups by indicating the present state of the USB control unit, 20 indicating communication states during updating information between the USB hard drive and the USB control unit, or indicating message regarding vehicle troubles when it is judged that there are trouble inside the USB control unit and abnormal signs from control units in the existing vehicle, and the indicators may be implemented through display devices such as audio displays mounted in a vehicle, a navigator (navigation system),

AUTO PC, and the like, or embodied in association with the display devices.

Describing the vehicle interface used for communications between the USB control unit of FIG. 4 and respective parts of a vehicle, the vehicle interface 307 includes interfaces 401 such as CAN/K-Line and the like for connecting various self diagnosis connectors with the USB control unit, sensor interfaces such as A/D converter 402 for transferring output values of various vehicle sensors to the USB control unit, and an interrupt decoder 403 for decoding interrupts for changing convenience apparatus setting values stored in the USB control unit by recognizing the changed convenience apparatus settings during running. Hereinafter, a more detailed description on each of the same will be carried out.

The USB control unit communicates to the self diagnosis connectors for collecting information on various vehicular control units such as the ECU, TCU, ABS control units, AIR BAG control unit, and so on, through the interfaces such as CAN BUS, K-Lines, and so on, of the vehicle interface 307. For the vehicle diagnosis, the self diagnosis connectors 404 are physical connectors positioned in the ECU, in the engine room, or adjacent the driver's seat and connected to vehicular diagnosis equipment such as a high-resolution scanning device in the existing repair ship and for grasping basic vehicle states, and protocols for the K-Line, CAN type, and so on as interfaces for reading in error codes of various control units from the connectors are so known as the international standards (ISO) and industrial standards that detailed descriptions are omitted. Further, error codes occurring as responses to requesting data from the ECU and the like by using these protocols and error codes interpretations may be obtained from each vehicle maker.

Further, the CPU 309 requests data for such vehicular error code items to the

vehicular control units through vehicle interface 307, reads in and interprets a response for each item through the vehicle interface 307, and, if the response value for the corresponding item is not a normal value, stores the value in the first memory 301 of the USB control unit while transferring to the USB hard drive in a manner to be described in  
5 FIG. 5 and storing the value.

In the meantime, outputs of various sensors, such as vehicle speed sensors, injector driving signals, throttle valve position sensors (TPS), air volume sensors, temperature sensors (water temperature, exhaust gas, etc.), intake air sensors (MAP Sensor, Airflow Sensor, Kalman vortex sensor, etc.), and so on, for diagnosing problems detected  
10 from vehicle sensors and collecting vehicle operation information and driver's driving characteristics information, and battery voltage inputs for checking battery voltage states are converted in the sensor interfaces, with current outputs or voltage outputs from vehicle sensors as inputs, typically implemented in a form of the A/D converter 402, and the conversions are transferred to the CPU 309 for detections.

15 The CPU 309 performs calculations for the present vehicle operation states and driver's driving characteristics obtainable from the output values of the aforementioned various sensors (in such a manner as vehicular average speed, highest speed, lowest speed, vehicular average RPM, highest RPM, lowest RPM, and so on) and stores the resultant values in the memory of the USB control unit, determines that the various outputs have  
20 been changed in designated output ranges in accordance with such vehicular operation states, and, when the values diverge from the designated output ranges, stores the values in the memory of the USB control unit. The vehicular sensor output information stored in the USB control unit is transferred to the USB hard drive in such a manner as described in FIG. 5 later, and transferred to the main server 140 of the central A/S center described

later or to an off-line independent program through the USB hard drive, to be used for indications as to sensors' normal and abnormal states, maintenance items related to consumables replacements based on users' driving characteristics, and so on.

Further, the vehicular interface 307 decodes signals occurring when a driver  
5 changes the settings of the vehicular convenience apparatus during driving and notifies the CPU of which convenience apparatus setting is changed, and, according to vehicles, inputs information on power mirror adjustment switches connected in a manner of the LAN, CAN or direct connections, seat adjustment switches, car audio users provided through the CDI interface and the like, and so on, transfers the data to the CPU to be stored in the USB hard  
10 drive, or plays a communication interface apparatus role that can read in the user convenience apparatus setting values transferred from the USB hard drive through the CPU, control driving devices such as motors attached to respective user convenience apparatus, and re-set the convenience apparatus.

A method for collecting vehicular internal data by use of the USB control unit  
15 having the aforementioned structure will be described hereinafter with reference to a flow chart of FIG. 5 showing a process for collecting vehicular internal data by the system of the present invention.

In the system of the present invention, the USB control unit 103 mounted in a vehicle is connected with various control units and sensors in the vehicle and detects  
20 changes occurring in all parts through the vehicular control units and sensors from the moment that electric power is applied with a vehicle key insertion after a driver gets in the vehicle. If a driver gets in a vehicle and electric power is supplied to the USB control unit with the insertion of a vehicle key, the CPU 309 transfers self diagnosis commands to various vehicular control units through the CAN/K-Line in the vehicular interface 307 by

using the self diagnosis connectors 404(S510). Thereafter, the various control units reply to the transfers and transfer the error codes of respective control units to the CPU 309 through the CAN/K-Line, and the CPU receives the error codes (S515). The CPU 309 analyzes the received error codes and determines whether the respective control units  
5 and all the respective vehicular parts that the control units controls are normally operating (S520). If it is determined that all the parts are normally operating, the USB control unit determines whether setting times lapse in order to check sensor output values (S525).  
The time period for checking such sensor output values may be diversely set based on the operation capability of the CPU of the USB control unit, and such setting values are  
10 counted by a Timer/Counter of the CPU 309.

If the setting time does not lapse, the USB control unit proceeds to the step(S510) and again transfers self diagnosis commands to the respective control units, and, if the setting time has lapsed, the USB control unit inputs the sensor output values of the vehicle such as inputting a vehicle speed through a vehicle speed sensor, inputting an RPM as an  
15 injector driving signal, and so on, and stores temporarily the output values in the RAM 306 of the USB control unit. By using the sensor output values temporarily stored, the present vehicular running states and driver's driving characteristics are analyzed in the CPU 309 through the algorithmic operations for calculations of a vehicular average speed, highest speed, lowest speed, vehicular average RPM, and highest and lowest RPM (S535),  
20 and such analyzed results are stored in the first memory 301 of the USB control unit together with the sensor output values collected in the step S530 (S540). After the collection and analysis of the sensor output values, described above, the USB control unit again proceeds to the step S510 and transfers the self diagnosis commands to the vehicular control units.

As an analysis result of error codes received as responses to the self diagnosis commands, if determined as abnormal responses, such error codes is stored in the first memory 301 of the USB control unit (S550).

The USB control unit, after storing the error codes, determines whether the USB  
5 hard drive is connected to the USB control unit (S555). If the USB hard drive is not connected, the step S510 again proceeds for transferring the self diagnosis commands since the USB hard drive can not be updated with the error codes, the sensor output values and analysis results stored in the USB control unit in the step S540, and, if the USB hard drive is connected, an authentication step S560 proceeds for determining that the USB hard drive  
10 belongs to the present vehicle. The USB hard drive authentication is carried out through the comparisons of both of a USB hard drive key and a USB control unit key in which the key used for the authentication may be generated by using a vehicular inherent number such as vehicle frame number, engine block number, or the like. If it is authenticated that the USB hard drive can be used for the present vehicle, as stated above,  
15 the data stored in the USB control unit is recorded in the USB hard drive without any comparisons of the stored information data in the USB hard drive and the USB control unit since the stored data is the latest (S565). After recording the changed data in the USB hard drive, for the case that a USB hard drive connected at present is replaced with a different USB hard drive from the USB hard drive connected just after the vehicle key  
20 insertion or that a USB hard drive is connected after the vehicle key insertion, a step S630 in FIG. 6 proceeds to update the data in both of the USB hard drive and the USB control unit with the latest data.

FIG. 6 is a flow chart for illustrating a process for updating data to the latest between the USB hard drive 101 and the USB control unit 103 in the system according to

an embodiment of the present invention.

If a vehicle key is inserted in FIG. 6, the USB control unit determines whether the USB hard drive is connected (S610). If the USB hard drive is not connected, the USB control unit can not update data through the comparisons with the USB hard drive, so that

- 5 step S510 proceeds for transferring the self diagnosis commands to detect the latest data of the vehicle, and, if the USB hard drive is connected, a step S620 proceeds for authenticating the connected USB hard drive. The step for authenticating the USB hard drive for whether the USB hard drive belongs to the present vehicle, as in FIG. 5, is carried out by comparing the USB hard drive key and the USB control unit key generated
- 10 by using the vehicular inherent number such as frame number or engine block number.

If the USB hard drive is not authenticated as a USB hard drive suitable for the present vehicle, as in the case that the USB hard drive is not connected, the step S510 for detecting the latest vehicle data proceeds, and, if the USB hard drive is authenticated as a USB hard drive suitable for the present vehicle, a step S630 proceeds for comparing the USB control 15 unit data and the USB hard drive data to each other. The step for comparing the data to each other can be carried out by determining whether differences exist through the comparisons between the all the data stored in the USB hard drive and all the data stored in the USB control unit, but, more preferably, the comparisons in the step S630 can be carried out by comparing the magnitudes of numeric values such as date updated at the latest, 20 mileage, accumulation number of times for updates, and the like, to thereby update old data with data updated at the latest (S640). At this time, the data to be updated to the USB control unit from the USB hard drive is the latest vehicle maintenance records stored in the USB hard drive through a method explained in FIG. 1 and FIG. 7 to be described later, and the data to be updated to the USB hard drive from the USB control unit is the

latest vehicle data such as error code values, sensor output values, and so on, stored in the USB control unit by a method described in FIG. 5.

FIG. 7 is a flow chart for illustrating a process for vehicle diagnosis and repairs through a PC or a independent terminal in a vehicle repair shop. When a vehicle is  
5 garaged in various kinds of vehicle repair shops providing joint services, a driver connects the USB hard drive 101 belonging to the vehicle to the second USB driver 111 attached the PC or the independent terminal in an vehicle repair shop (S710). The connected USB hard drive is detected by the vehicular control units and sensors through the steps described in FIG. 5 and FIG. 6, and all the data recorded and stored in the USB control unit 103 and  
10 the USB hard drive is read from the USB hard drive 101 to the second USB driver 111 (S720). The read data is displayed on the PC 112 connected to the USB driver 111(S730), and maintenance items are checked through a diagnosis program or mechanic's experiences based on the read data (S740), and, at this time, in case that the maintenance items are checked by the maintenance program, the number of the maintenance items may  
15 be determined according to the capacity of the program. The mechanic replaces consumables or repairs the vehicle based on the checked items (S750), inputs the items to be worked out into the PC 112, and, if completely worked out, records the worked-out results into the USB hard drive 101 through the USB driver 111(S760). The latest maintenance data recorded in the USB hard drive is updated to the USB control unit  
20 through a process described in FIG. 6 as in the case that a driver connects the USB hard drive to the USB control unit 103 of the vehicle, so that the latest maintenance data can be maintained in the USB control unit all the time.

If on-line environments are built up as in the case that the various kinds of repair shops providing joint services has an internet-accessible terminal, the terminal transfers to

the central vehicle A/S center main server 140 the data updated for customer managements to store in a database the kind of vehicle, year, A/S date, A/S items, maintenance contents, repair shop records, and so on, and the main server 140 can receive and database the vehicle diagnosis data detected by the vehicular control units, sensors, and so on, and  
5 stored in the USB control unit. The data so collected is utilized as statistics data for vehicular pre-diagnosis services and for vehicle parts improvements and new vehicle developments.

If a vehicle owner drops by at a shop providing repair services without the USB hard drive, the data in the USB control unit 103 is used since the latest maintenance data is  
10 stored in the USB control unit 103 according to the above process. In this case, if the USB hard drive (maintenance-purpose USB hard drive) the repair shop keeps, is connected to the USB control unit and a reset key pressed, as stated above, the basic vehicle information data of the USB control unit and the vehicle maintenance-related data are stored in the USB hard drive. The USB hard drive is connected back to the USB  
15 driver and the aforementioned maintenance service is performed, and the results of which are stored in the USB control unit through the same USB hard drive.

Hereinafter, FIG. 8 showing a flow of a process for diagnosing a vehicle on-line by using the USB hard drive, and FIG. 9 and FIG. 10 showing on-line vehicle diagnosis system structures will be described. When a user wants to know problems occurred to  
20 a driving vehicle, the present states of the vehicle, or the like, the user connects a USB hard drive belonging to his vehicle to various on-line access devices, such as computer, mobile phone, or the like(S810), in which the USB driver 121 is attached, and thereafter connects to the central A/S center main server 140 through a network such as the internet(S820).

First, the user connects, through a network, to a web server 1030 of a central A/S

center implementing a web interface 925 wherein the web server uses a method of XML, HTML, or the like and has the capacity enabling to display multi-dimensional data and various multimedia information on the basis of graphic environments on the web and enabling the user to check the data input and process results therefrom. Once the web 5 server 1030 is connected, an authentication server 1020 authenticates whether the connected USB hard drive is a USB hard drive entitled to services, and, at this time, the authentication process is to compare and check vehicular inherent information, such as vehicle maker, kind of vehicle, year, or the like, stored in the aforementioned USB hard drive, and then to authenticate whether the vehicle is a vehicle for which the central A/S 10 center main server 140 provides services(S830). If the USB hard drive is not authenticated as a USB hard drive for which services can not be provided by the connected central A/S center main server 140, the on-line vehicular diagnosis process comes to an end. If the USB hard drive is authenticated by the authentication server 1020, the basic vehicular information data and maintenance information data updated in the USB 15 hard drive through a process described in FIG. 5 and FIG. 6 are transferred to the central A/S center main server on-line(S840).

The central A/S center main server 140 having received the data performs a maintenance program in a database server 1010, detects error codes from the vehicular control units based on the received data, and stores the diagnosed results in a vehicle 20 diagnosis result database 930(S850). In more details, first, if data, such as error codes inputted from the USB hard drive and the like, is collected, an inference engine 915 inputs the data and extracts knowledge from experts as to a vehicle in a form of a single error code or combined error codes occurable as to vehicle trouble states or in an expertise form, builds the knowledge by using a knowledge acquisition system 920 converting the

knowledge into a form storable in a knowledge base 910, and draws out proper solutions through various inference methods from the knowledge base 910 consisting of materials of trouble diagnosis rule, procedures, and the like. The solutions are materials as to vehicle problems and solutions to the problems, parts to be replaced, various statistics data 5 related to driver's driving habits, and improvement directions, and displayed through a computer monitor in case that a device connected to the central A/S center main server through the network is a computer or through transfers by way of a method such as a text service and the like in case the connected device is a communication terminal such as a mobile phone(S860).

10 In the meantime, together with the results diagnosed and displayed through the above procedures, the user 940 may store in the vehicle diagnosis result database 930 complaints as to the vehicle diagnosis results or vehicle problems through the web interface 925, so that a vehicle maker 950 may use data stored in the database 930 and grasp drivers' preferences by vehicle, control unit problems by vehicle, and the like, and 15 vehicle experts may update the knowledge base through the knowledge acquisition system 920 in order for the vehicle diagnosis results to become more precise through the inference engine. By such procedures, a vehicle user gets to know required maintenance items without driving directly to a repair shop, and, a vehicle maker can grasp vehicle problems, consumers' complaints, and the like, as to vehicles sold without checking the sold vehicles 20 one by one, through the database 930.

With reference to FIG. 11 showing a flow of an off-line vehicle diagnosis process by using the USB hard drive and to FIG. 12 showing a system structure for FIG. 11, an off-line vehicle diagnosis process will be described. In case that a vehicle driver can not connect to the central A/S center main server 140 on-line, he or she can perform an off-line

self diagnosis by using an independent device such as the PC 122 connected to the USB driver 121. First, a user executes a corresponding maintenance diagnosis program in an independent device such as the PC, and, at this time, the diverse program to be executed may be selected according to the process capacity and the number of maintenance 5 diagnosis items of the independent device(S1110). After a diagnosis program is executed, the user connects the USB hard drive to the USB driver 121(S920), the independent device authenticates whether the USB hard drive is entitled to receive the diagnosis service through the executing program at present, and the process of the authentication is the same as in FIG. 8(S1130). If the connected USB hard drive 101 10 is not authenticated with a determination as a USB hard drive that can not be served through the presently executing program, the off-line maintenance diagnosis process comes to an end, but, if the USB hard drive is authenticated, data regarding inherent information and maintenance information such as error codes and sensor output values collected from a vehicle is read and transferred from the USB hard drive to the 15 independent device by the USB driver (S1140). The independent device executes a diagnosis program as to the data transferred, carries out pre-diagnosis or problem diagnosis, and checks maintenance recommendation items or presently required maintenance items through the program (S1150).

Describing the aforementioned process in more detail, a user connects to an 20 inference engine 1215 through a user interface 1225 performing the same functions as those of the web interface 925 of FIG. 9. That is, the error codes, sensor outputs, and maintenance information read from the USB hard drive by the USB driver 121 and collected from a vehicle are transferred to a software-implemented inference engine 1215 through a user interface, and the inference engine applies the vehicle

diagnosis rules and diagnosis determination procedures provided from the knowledge base 1210 to the data received from the USB hard drive, analyzes error codes by using various inference methods, and diagnoses vehicle problems. The knowledge base in such an off-line vehicle diagnosis method is updated by purchasing a material-updated CD or an 5 upgraded diagnosis program.

The vehicle problems, consumables replacement schedule, and the like, as the results checked through the above method are displayed on the independent device(S1160). As in the on-line vehicle diagnosis, required maintenance items can be obtained without dropping off a vehicle in a repair shop directly through such an off-line vehicle diagnosis 10 process.

Hereinafter, referring to FIG. 13a and FIG. 13b, a method for automatically setting a vehicular convenience apparatus by using the USB hard drive will be described. FIG. 13a and FIG. 13b show a method for automatically setting the vehicular convenience apparatus based on data stored in the USB hard drive according to the present invention.

15 In order to automatically set the vehicular convenience apparatus by using the data of the USB hard drive 101, it must be a prerequisite that a vehicle is not in operation for the sake of driver's safety. Accordingly, if a driver gets in a vehicle and inserts a key for electric power to switch on, the central control unit of the vehicle first checks if the vehicle is in operation(S1301). If the vehicle operates, for safety' sakes, it is not determined 20 whether or not a USB hard drive is connected but a step(S1340) for determining whether the existing convenience apparatus is changed proceeds to avoid changing the convenience apparatus by reading convenience apparatus setting data from the USB hard drive.

If the vehicle is not in operation, the vehicular central control unit first checks if the USB hard drive 101 is connected to the USB control unit 103, in order to read the

convenience information from the USB hard drive(S1305). If a vehicle key is inserted and the USB hard drive is not connected in the non-operation state, the central control unit repeats the steps S1301 and S1305 until vehicular changes occur by the driver, but if the USB hard drive is connected in the non-operation state, the central control unit 5 proceeds to a step for authenticating the connected USB hard drive. The USB hard drive authentication step compares the USB hard drive key and the USB control unit key to each other, and, in this case, the authentication key may be, as in steps of FIG. 5 and FIG. 6, generated by using a vehicular inherent number such as vehicular frame number, engine block, and so on. Data from the USB hard drive can not be read in case that an 10 authentication is not made since the USB hard drive does not belong to a vehicle, so the central control unit proceeds to a step S1340 for checking if previous convenience apparatus settings are changed. In case that the USB hard drive 101 is authenticated, the USB control unit 103 reads convenience apparatus-related data from the USB hard drive and stores it in the RAM 306 which is a temporary storage location in the USB 15 control unit 103, and, at this time, the read convenience apparatus data is audio-related information such as driver's favorite radio frequency selection, volume control, CD-EQ setup, and information data related to driver's convenience such as vehicle cabin temperature, side view mirror adjustments, driver's seat height and tilt, steering wheel's position and tilt, and so on, but may include data relating to all device controls which can 20 be electronically controlled in the central control unit of a vehicle(S1320). Further, the USB control unit 103 reads present convenience apparatus setting values(A) from the fourth memory 304 of the USB control unit 103 (S1325) and compares the values A with the convenience apparatus setting values B from the USB hard drive stored in the RAM 306(S1330). In case that the present convenience apparatus setting values A and the

values B stored in the USB hard drive are the same as the comparison results, there is no need to re-set the convenience apparatus, so the USB control unit 103 proceeds to a step (S1340) for checking if the convenience apparatus is changed during driving. However, if the setting values are not coincident as the comparison result, the USB control 5 unit 103 proceeds to a step for changing the convenience apparatus settings.

The operations for setting vehicular convenience apparatus in the present invention are carried out by applying signals occurring from the user's switch on/off manipulations to driving devices such as various vehicular actuators, motors, and so on, through vehicular interfaces. Further, the CPU calculates, based on duration times of such signals, 10 corresponding vehicular convenience apparatus displacement values (signal duration time \* operation speed of a corresponding convenience apparatus actuator or a driving device such as motor or the like) and transfers the displacement values to the fourth memory 304 and the USB hard drive as convenience apparatus setting values for storage, and, for example, with consideration of the case that a user excessively keeps switching on even 15 though a power side view mirror moves to the left, right, up or down to the maximum, when the user continues to manipulate a convenience apparatus switch beyond an operation range, maximum displacement values to a positive(+) or a negative(-) direction are stored for respective convenience apparatus. Accordingly, the present convenience apparatus setting values A in step S1325 and the values B stored in the USB 20 hard drive in step S1330 mean convenience apparatus displacement values respectively, the convenience apparatus moves in a positive(+) or negative(-) direction according to the comparison results of the displacement values A and B. For example, if A is larger than B as the comparison results of the displacement values A and B, the convenience apparatus moves in the negative direction by the differences between values A and values

B (S1331), and, if A is less than B, the convenience apparatus moves in the positive direction by the differences between values A and values B(S1333). After having moved the convenience apparatus by the differences between values A and values B, the presently changed convenience apparatus setting values are stored in the fourth memory 5 304 of the USB control unit, and a step S1330 proceeds for comparing with the values B stored in the USB hard drive.

In the meantime, in state that the USB hard drive is not connected, in case that a vehicle key is inserted, the connected USB hard drive is not authenticated, or the present convenience apparatus setting values are the same as the setting values stored in the USB 10 hard drive, the CPU monitors the changes of various convenience apparatus switches and the like in a manner of interrupt, timer loop, or the like, and checks whether the convenience apparatus settings are changed by the user (S1340). If the CPU detects convenience apparatus setting values changed by a monitoring routine, the CPU checks which of the various convenience apparatus settings is changed (S1350), and detects the 15 displacement values by the differences changed by the user (S1355). Thereafter, the vehicular central processing unit loads setting values corresponding to the changed convenience apparatus items from the fourth memory 304 of the USB control unit (S1360), and calculates final absolute displacement values by adding the changed displacement values to the displacement values stored in the USB control unit (S1365), and updates 20 convenience apparatus setting information by storing again the calculated values in the fourth memory 304 of the USB control unit (S1370).

The USB control unit checks whether the USB hard drive is connected in order to update again the USB hard drive with the updated convenience apparatus setting information (S1375), and, since the latest convenience apparatus setting data can not be

updated if the USB hard drive is not connected, that is, in case that the USB hard drive is connected at the beginning but removed later, or not connected from the beginning, a step S1340 proceeds for checking whether other setting data is changed. If the USB hard drive is connected to the USB control unit after updating new data in the memory of the

- 5   USB control unit, a step S1380 proceeds for authenticating the USB hard drive so that the USB hard drive is authenticated in the same way as the above step S1315. The authentication step S1380 is required for the case that the USB hard drive first connected is replaced with a different USB hard drive in the middle or the USB hard drive is connected later. If the USB hard drive connected is not authenticated since it does not belong to
- 10   the present vehicle, the changed data can not be updated into the USB hard drive so that the step S1340 proceeds for checking whether new convenience apparatus settings are changed, and, if authenticated, the latest convenience apparatus setting data stored in the fourth memory 304 of the USB control unit is updated into the USB hard drive(S1385). After the data changed by the USB hard drive is updated, it is checked whether a vehicle
- 15   key is removed, that is, whether a user is still driving his vehicle(S1390), and, if the vehicle key is not removed, other convenience apparatus settings may be changed so that the step S1340 again proceeds for checking the settings, and, if the vehicle key is removed, the steps for automatically setting and updating the convenience apparatus become complete.

## 20   **Industrial Applicability**

With the aforementioned structure, the first memory 301 of the USB control unit stores the latest information sensed from various vehicular control units and sensors all the time, and, further, the USB hard drive 101 stores the latest maintenance data, so that the information and the data are updated to each other when the USB hard drive is connected

to the USB control unit.

By using the data stored in the USB hard drive 101 and the USB control unit 103, a vehicle driver transfers the vehicle problems and the latest maintenance data stored in the USB hard drive through a network under on-line environments so as to receive vehicle diagnoses being carried out in the central A/S center main server 140 or, in case that the on-line environments are not built up, the driver uses programs running in an independent device such as PCs and the like so that the driver can grasp various vehicular problems in a convenient and simple manner and work on self diagnoses enabling to determine various consumables replacement periods and states, to thereby enable to reduce the time and cost required in the existing maintenance/repair forms.

Repair shops use the log data stored in the USB hard drive as well as diagnosis results transferred from the central A/S center to enable objective and expert vehicle maintenance as to diverse vehicle problems occurring intermittently or continuously, thereby enhancing maintenance reliability and reducing the required time and cost. Further, such maintenance results are stored in the USB hard drive and used afterward when necessary, so that systematic and integral vehicle maintenance can be carried out.

Further, a vehicle user, even under circumstances in which a network is not connected, transfers maintenance information data stored in the USB hard drive to a terminal to which a USB hard drive can be connected (for example, PC) and carries out vehicle diagnoses on a program as simple self diagnoses, so there is an effect of reducing time and cost.

However, even though a repair shop does not have various network interface environments, a vehicle user reads in the log data stored in the USB hard drive in use of only his own USB hard drive through executing an application program in an independent

PC or terminal, to thereby enable effective vehicle maintenance.

In the meantime, a driver connects the USB hard drive to the USB control unit upon riding a vehicle and read out the driver convenience information data of the USB hard drive into the memory of the USB control unit to enable the convenience apparatus to  
5 be automatically controlled, and, changed items as to the convenience apparatus controlled during driving are automatically stored in the USB control unit and the USB hard drive so that the driver can use the convenience apparatus without need to control them every time the driver gets in his vehicle.

Further, a vehicle maker, since an individual or a repair shop transfers data stored  
10 in the USB hard drive to the central A/S center main server 140 in on-line environments for maintenance and diagnoses, can build up an expert database by using the data, have statistical data according to vehicle kind, year, and so on, based on these accumulated materials, recognize in advance problems frequently occurring as to the same vehicle kind and solutions to the problems, flexibly meet vehicle troubles by securing a proper stock  
15 level of vehicle parts and the like, and provide better A/S, so that there is an effect being able to provide services distinct over other makers as well as a cost-effective advantage resulting from enabling to effectively secure a stock of vehicle parts. Further, such database materials can be used as very useful ones when developing new vehicles.

The embodiments of the present invention described so far is exemplary, and all  
20 the changes and modifications as to the embodiment should be understood as belonging to the scope of claims expressly defined below.